REMARKS

First, Applicants acknowledge, with appreciation, Examiner Maldonado's courtesy and professionalism in correcting the Office Action mailed on February 28, 2003 with resetting a three month period.

At the time of the Office Action dated April 21, 2003, claims 6-10 and 12-18 were pending. In this Amendment, claims 6-10 and 13-18 have been amended. Specifically, claim 6 has been amended to include the limitation "comprising the sequential steps of forming a film containing silicon...; roughening an outer surface of said film... ; and conducting an anisotropic etching...." Adequate descriptive support for the amendment can be found in, for example, the second full paragraph at page 16 of the specification. Cosmetic amendment has also been made to claims 7-10 and 13-18 to improve wording and remove possible antecedent basis issues. No new matter is introduced.

The Office Action asserted that Applicants' amendment necessitated the new ground of rejection and thus this action was made final. However, Applicants submit that Amendment filed December 20, 2002 did not necessitate the new ground of rejection for the reason set forth below, and thus the finality of the Office Action are improper. Therefore, entry of the present Amendment and favorable consideration are respectfully solicited.

Applicants note that the claim for foreign priority and receipt of the certified copies of the priority document filed in Serial No. 09/086,752 on May 29, 1998 have not been acknowledged. Applicants hereby respectfully request that the Examiner clarify the record by acknowledging the claim for foreign priority and receipt of the certified copies of the priority documents.

Finality.

Applicants note that the present Office Action dated April 21, 2003 has incorrectly been designated as final. In this regard, the Examiner is referred to MPEP §706.07(a), which is reproduced in part below:

> Under present practice, second or any subsequent actions on the merits shall be final, except where the examiner introduces a new ground of rejection that is neither necessitated by applicant's amendment of the claims nor....

In the non-final Office Action dated August 20, 2002, independent claim 12 was rejected under 35 U.S.C. §103(a) as being unpatentable over Hsieh et al. in view of the applicant admitted prior art in the instant application and DeBoer et al. In the Amendment filed December 20, 2002, independent claim 12 was amended to recite the underlined limitation "forming a dielectric film on said cylindrical storage node comprising said cylindrical portion and said bottom portion within which said core remains." In the present Office Action, claim 12 has been rejected under 35 U.S.C. §103(a) as being unpatentable over Hsieh et al. in view of the applicants admitted prior art in the instant application, DeBoer et al. and Dennison et al. Dennison et al. is a newly cited reference, based on which the Office Action has issued the new ground of rejection of claim 12.

Applicants submit that the amendment made to claim 12 was for a cosmetic purpose to improve clarity, as mentioned in the Amendment filed December 20, 2002. The Examiner is referred to the following limitations recited in claim 12 with markings showing changes made in the previous Amendment.

> ~~a step of~~ patterning by an anisotropic etching said insulating film and said electric conductive film to form a configuration corresponding to said cylindrical portion so that the core and the bottom portion of said cylindrical portion are formed;

~~a step of~~ forming the cylindrical portion on the side of said core and said bottom portion wherein an outer wall of said cylindrical portion is roughened;

~~a step of~~ forming a dielectric film on said cylindrical storage node comprising said cylindrical portion and said bottom portion within which said core remains; and

~~a step of~~ forming a cell plate on said dielectric film, whereby a capacitor constituted by said cylindrical storage node, said dielectric film and said cell plate is formed.

According to the above limitations, the core is formed in the step of patterning. On the side of the core is the cylindrical portion, on which the dielectric film is formed. Then, the cell plate is formed on the dielectric film.

It is apparent that the core is not removed, i.e., the core is supposed to remain in the cylindrical storage node according to original claim 12. The amendment of adding to claim 12 the limitation "within which said core remains" is therefore inherent. Accordingly, the final rejection is not proper because the Office Action introduced the new ground of rejection not necessitated by amendment of the claim. Applicants respectfully solicit withdrawal of the finality of the present Office Action and entry of the above Amendment.

Claims 7, 9, 10 and 13-18 have been rejected under 35 U.S.C. §112, first paragraph.

The Examiner asserted that subject matter is not described in the specification in such a way as to enable one skilled in the art to make and/or use the invention because there is no support in the specification **to claim a roughened amorphous silicon layer**. To support his assertion, the Examiner relied on Sandhu et al. describing that the phase transition temperature from amorphous silicon to polycrystalline silicon is at 550°C. It is Applicants' understanding that the Examiner appeared to consider that the inner wall of the cylindrical portion of the claimed invention cannot be constituted by amorphous silicon because the specification discloses higher temperature than that of Sandhu et al.

In response, Applicants submit that an ultimate semiconductor device having a capacitor with a roughened amorphous silicon layer is not being claimed. Rather, the claims are directed to a **method**, which involves a **step of roughening the amorphous silicon**.

In the twelfth enumerated paragraph, the Office Action also asserted that "claim 7 cites '... roughening an outer surface of said amorphous silicon by forming silicon grains in the outer surface...'" and "Therefore, according to claim 7, a roughened amorphous silicon layer is being claimed." Again, Applicants submit that claim 7 recites the step of "roughening an outer surface of said amorphous silicon," but does **not** recite a "roughened amorphous silicon layer."

With respect to the Examiner's assertion of the temperature, Applicants explain a basic idea of temperature for the roughening step. The starting temperature of crystallization of amorphous silicon changes depending on the density of micro crystals present in the amorphous silicon. Also, even if the temperature setting for the crystallization process is constant, actual temperature at the surface of a substrate where the crystallization takes place, changes depending on various parameters, such as annealing method, pressure, time, atmosphere and device structure. Those parameters affect temperature the surface of an amorphous silicon film.

Accordingly, Applicants submit that both the specification and Sandhu et al. simply provide examples of the temperature setting, which may be varied by a person skilled in the art based on the above parameters. Even if the specification and Sandhu et al. mention different temperature, the description of the invention itself is sufficient to permit those skilled in the art to make and use the invention without undue experimentation.

It is therefore submitted that the Examiner does not establish the a *prima facie* basis to deny the enablement of the claimed invention. Applicants respectfully solicit withdrawal of this rejection.

Claims 6-10 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Hsieh et al. in view of the applicants admitted prior art ("AAPA") in the instant application and DeBoer et al.

In the statement of the rejection, the Office Action admitted that Hsieh et al. fails to teach that the configuration of the lower electrode is cylindrical. Then, the Office Action cited AAPA (Figs. 6 and 7) and asserted that it teaches forming a DRAM capacitor structure in which the lower electrode (5a) is cylindrical. The Office Action further admitted that the proposed combination of Hsieh et al. and AAPA fails to expressly teach roughening the outer wall of the cylindrical storage electrode. However, the Office Action cited DeBoer et al., asserting that it teaches the step of roughening the outer wall of a storage electrode (70a). Then, the Office Action concluded that it would have been obvious to combine the teachings of DeBoer et al. with the teachings of Hsieh et al. and AAPA to enable the roughened surface of DeBoer et al. to be formed.

Claim 6.

With respect to claim 6, the Office Action asserted in response to Applicants' argument filed December 20, 2002[1] that "the feature upon which applicant relies (i.e., roughening treatment is conducted right after the formation of the film containing silicon) are not recited in the rejected claims(s)" (the twelfth enumerated paragraph of the Office Action).

In response, Applicants have amended claim 6 as attached. Applicants respectfully request the Examiner to enter and consider the amendment of claim 6.

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[1] Although the Office Action stated that "Applicant's arguments filed 01/07/2003 have been fully considered...," Applicants' argument was filed on December 20, 2002.

Based on this amendment, Applicants submit that the proposed combination does not disclose the limitations recited in claim 6 "forming the cylindrical portion on the side of said core and said bottom portion wherein an outer wall of said cylindrical portion is roughened, comprising the sequential steps of forming a film containing silicon on said core and said bottom portion; roughening an outer surface of said film containing silicon by forming silicon grains in the outer surface of it; and conducting an anisotropic etching for patterning to form said cylindrical portion a side-wall like shape at the side of said core and said bottom portion."

The Office Action specifically cited Figs. 12-16 of DeBoer et al., asserting that it teaches "the step of roughening the outer wall of a storage electrode (70a)." However, Applicants submit that Figs. 12-16 and their corresponding explanation in DeBoer et al. do not disclose the above mentioned limitations. For example, the explanation as to Fig. 15 of DeBoer et al. is reproduced below.

> Referring to FIG. 15, silicon-containing capacitor container structures 70a are formed over the outer surfaces of blocks 92, 94. The illustrated and preferred structures 70a are formed over support walls 88, 90 and include outer surfaces 72a. Preferably, structures 70a constitute roughened or rugged polysilicon. Even more preferably, such constitutes HSG polysilicon. Structures 70a can be fabricated, for example, by deposition and subsequent anisotropic etch of a polysilicon or amorphous silicon layer. This leaves portions of layer 86 elevationally between and in operative contact with structures 70a and plugs 38, 42 respectively (column 7, lines 19-30).

Upon careful review of the above portion of DeBoer et al., it becomes clear that what DeBoer et al. discloses is rather **vague** and is **silent on the order of the steps** of forming the cylindrical portion on the side of the core and the bottom portion wherein an outer wall of the cylindrical portion is roughened. For example, it is unclear for Applicants even as to when the structures 70a are roughened because DeBoer et al. merely discloses, "Preferably, structures 70a constitute roughened or rugged polysilicon" (see above).

On the other hand, claim 6 clearly recites the surface roughening treatment is conducted right after the formation of the film containing silicon constituting the cylindrical portion. This provides a benefit that there is no danger of contamination of the film surface, because no step is conducted between the formation of the film and the surface roughening treatment.

Therefore, the proposed combination does not disclose all the limitations recited in claim 6.

Claim 7.

Claim 7 has been cosmetically amended. Applicants respectfully request the Examiner to enter and consider the amendment of claim 7.

With respect to claim 7, the Office Action asserted that "the features upon which applicant relies (i.e., roughening the outer surface at a lower position of the cylindrical portion 6d and near an upper surface of the interlayer insulating film 4) are not recited in the rejected claim(s)" (the twelfth enumerated paragraph of the Office Action). In response, Applicants submit that it is easy for one skilled in the art to understand that claim 7 clearly discloses the feature pointed out by the Examiner, even if claim 7 were not amended at this time. The relevant limitations recited in claim 7 are reproduced below.

(1) forming an amorphous silicon film on said core and said bottom portion;

(2) conducting an anisotropic etching of said amorphous silicon film to form said cylindrical portion a side-wall like shape at the side of said core and said bottom portion; and

(3) roughening said outer wall of said cylindrical portion by forming silicon grains.

When one skilled in the art read the steps (1), (2) and (3), he/she would picture a semiconductor device being produced in a manner as shown, for example, in Figs. 2(c), 4(a) and 4(b). Specifically, because the claim explicitly recites a step of roughening the cylindrical portion

formed at the side of the core and the bottom portion, one skilled in the art would understand that the outer surface at a lower position of the cylindrical portion and near an upper surface of the interlayer insulating film, i.e., the outer wall of the cylindrical portion over the bottom portion, can be roughened (see, for example, Figs. 4(a) and 4(b)). The Office Action also pointed out by citing the *In re Van Geuns* case that "Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims" (the twelfth enumerated paragraph of the Office Action). In response, Applicants submit that the *In re Van Geuns* case is irrelevant to this case, because the above explained understanding of claim 7 can be obtained based only on claim language itself.

DeBoer et al. does not teach or suggest the step of roughening the outer wall at a lower position of the cylindrical portion 6d and near an upper surface of the interlayer insulating film 4. In fact, as shown in Fig. 15 of DeBoer, the layer 86 does not show the result of the roughening treatment. Its exposed surface is smooth. In addition, Applicants submit that DeBoer does not teach or suggest the limitation "the inner wall of the cylindrical portion having the roughened outer wall is constituted by amorphous silicon." This is because DeBoer discloses a feature that the amorphous silicon layer is crystallized (column 4, lines 19-20), the feature which is contrary to that recited in claim 7.

Thus, consideration of the teachings of Hsieh et al., AAPA and DeBoer et al., either individually or in combination, would not have suggested each and every limitation of claims 6 and 7. In the instant case, the pending rejection has not established *prima facie* obviousness of the claimed invention as recited in claims 6 and 7, because the proposed combination fails to satisfy the all claim limitations standard required under §103. *In re Royka*, 490 F.2d 981, 180

USPQ 580 (CCPA 1974). Applicants, therefore, solicit withdrawal of the rejection of claims 6 and 7.

Dependent Claims 8-10.

If an independent claim is nonobvious under 35 U.S.C. §103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988). Accordingly, as claims 6 and 7 are patentable for the reasons set forth above, it is submitted that dependent claims 8-10 which respectively depend on claims 6 and 7 are also patentable. The Examiner's additional comments with respect to the claims do not cure the argued fundamental deficiencies of the proposed combination of Hsieh et al., AAPA and DeBoer et al. Applicants traverse the rejections of those claims and solicit withdrawal thereof.

Claims 12-18 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Hsieh et al. in view of AAPA, DeBoer et al. and Dennison et al.

In the statement of the rejection, the Office Action admitted that the proposed combination of Hsieh et al., AAPA and DeBoer et al. fails to teach forming a dielectric film on said cylindrical storage node comprising said cylindrical portion and said bottom portion within which said core remains. However, the Office Action newly cited Dennison et al., asserting that it teaches forming a dielectric film on a storage node comprising a sidewall portion (42) and a bottom portion (34) within which a "core" (38) remains. The Office Action then concluded that it would have been obvious to combine the teachings of Dennison et al. with the teachings of Hsieh et al., AAPA and DeBoer et al., to enable the "core" to remain over the bottom portion of the storage node of the capacitor structure. This rejection is respectfully traversed.

There is no motivation.

In imposing a rejection under 35 U.S.C. §103, the Examiner is required to make a "thorough and searching" factual inquiry and, based upon such a factual inquiry, explain **why** one having ordinary skill in the art would have been realistically impelled to modify particular prior art to arrive at the claimed invention. *In re Lee*, 277 F.3d 1338, 61 USPQ2d 1430, 1433 (Fed. Cir. 2002). Merely identifying features of a claimed invention in disparate prior art references does not, automatically, establish the requisite motivation for combining references in any particular manner. *In re Dembiczak*, 175 F.3d 994, 50 USPQ2d 1614 (Fed. Cir. 1999); *Grain Processing Corp. v. American-Maize Products Co.*, 840 F.2d 902, 5 USPQ2d 1788 (Fed. Cir. 1988).

In applying the above legal tenets to this case, it is apparent that the Examiner has **not** established the requisite motivational element. The Examiner has merely pointed to the acknowledged prior art and then announced, "it would have been obvious... to combine the teachings of Dennison et al. with the teachings of Hsieh et al., AAPA and DeBoer et al., to enable the core to remain over the bottom portion of the storage node of the capacitor structure" (ultimate sentence of the paragraph bridging pages 7 and 8 of the Office Action).

Applicants submit that the Office Action did not make it clear **where** the prior art discloses the motivation to combine the teachings of those references. *In re Lee, supra.* Moreover, based on Applicants' review, Dennison et al., Hsieh et al., AAPA and DeBoer et al. do not disclose any motivation to combine their teachings.

Dennison et al. discloses that "FIG. 19 illustrates an alternate embodiment whereby second dielectric layer 38 is not removed prior to application of the capacitor dielectric layer 48 and upper poly plate layer 50" (emphasis added) (column 6, lines 18-21). However, Dennison et al. also discloses that "Removal of layer 38 is preferred to further maximize the exposed area for

capacitance by utilizing the outer sides of rings 42" (emphasis added) (column 6, lines 21-23). It can therefore be considered that Dennison et al. recommend to remove the "core."

Further, Hsieh et al. and DeBoer et al. disclose a step of removing the "core," but do not disclose the "core" remains. AAPA is silent on the "core."

For example, Hsieh et al. discloses that "an oxide-dry-etching process or HF dip (stop on silicon nitride layer 40) is performed to remove the second oxide layer 51" and "FIG. 8 shows the resulting doped polysilicon structure, which serves as a bottom electrode 58 of DRAM cell capacitor with 'U shape' in cross section view" (column 4, lines 8-13). As shown in Figs. 7a and 8, Hsieh et al. discloses removing a "core" (second oxide layer) 51, but does not mention that the "core" 51 can remain there. Hsieh et al. further discloses in relation to Figs. 10a-10c showing the formation of TiN layers 62a-62c that "The sputtering process can cover a thin layer of low-resistance TiN on most flat area" and "the collimated-sputtering process can enhance the titanium nitride (TiN) formation on the bottom of deep small holes" (column 4, lines 28-38). According to these sentences, it can be considered that Hsieh et al. does not intend to have the "core" 51 in the bottom electrode 58.

DeBoer et al. discloses that "Referring to FIG. 16, support wall material laterally inwardly of outer surfaces 72a is removed, preferably through a suitable oxide etch which is conducted selectively relative to the material from which structures 70a are formed" and "Accordingly, blocks 92, 94 are removed" (column 7, lines 31-35). DeBoer et al. continues to discloses that "Subsequently, a capacitor dielectric layer 74a and an outer capacitor plate layer 76a are formed operably proximate structures 70a." (column 7, lines 36-38). DeBoer et al. also does not teach that the "core" (see blocks 92, 94) remains in the structures 70a.

Accordingly, Applicants submit that there is no motivation to combine the teachings of Dennison et al. with the teachings of Hsieh et al., AAPA and DeBoer et al., to enable the core to remain over the bottom portion of the storage node of the capacitor structure. In short, Hsieh et al. and DeBoer et al. teach that the "core" is removed, and also Dennison et al. teaches that removal of the "core" (layer 38) is preferred. No references describe the necessity to have the "core." It should, therefore, be apparent the a *prima facie* basis to deny patentability to the claimed invention has **not** been established for lack of the requisite factual basis and warranted the requisite realistic motivation. Applicants respectfully request the Examiner to show factual basis supporting the motivation to combine those references.

Dependent Claims 13-18.

If an independent claim is nonobvious under 35 U.S.C. §103, then any claim depending therefrom is nonobvious. *In re Fine*, *supra*. Accordingly, as claim 12 is patentable for the reasons set forth above, it is submitted that dependent claims 13-18 which respectively depend from claim 12 are also patentable. The Examiner's additional comments with respect to the claims do not cure the argued fundamental deficiencies of the proposed combination of Hsieh et al. in view of AAPA, DeBoer et al. and Dennison et al. Applicants traverse the rejections of those claims and solicit withdrawal thereof.

Conclusion.

Accordingly, it is urged that the application is in condition for allowance, an indication of which is respectfully solicited. If there are any outstanding issues that might be resolved by an interview or an Examiner's amendment, Examiner is requested to call Applicants' attorney at the telephone number shown below.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

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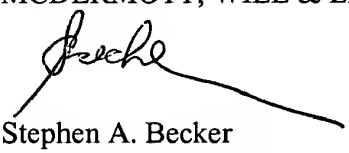

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